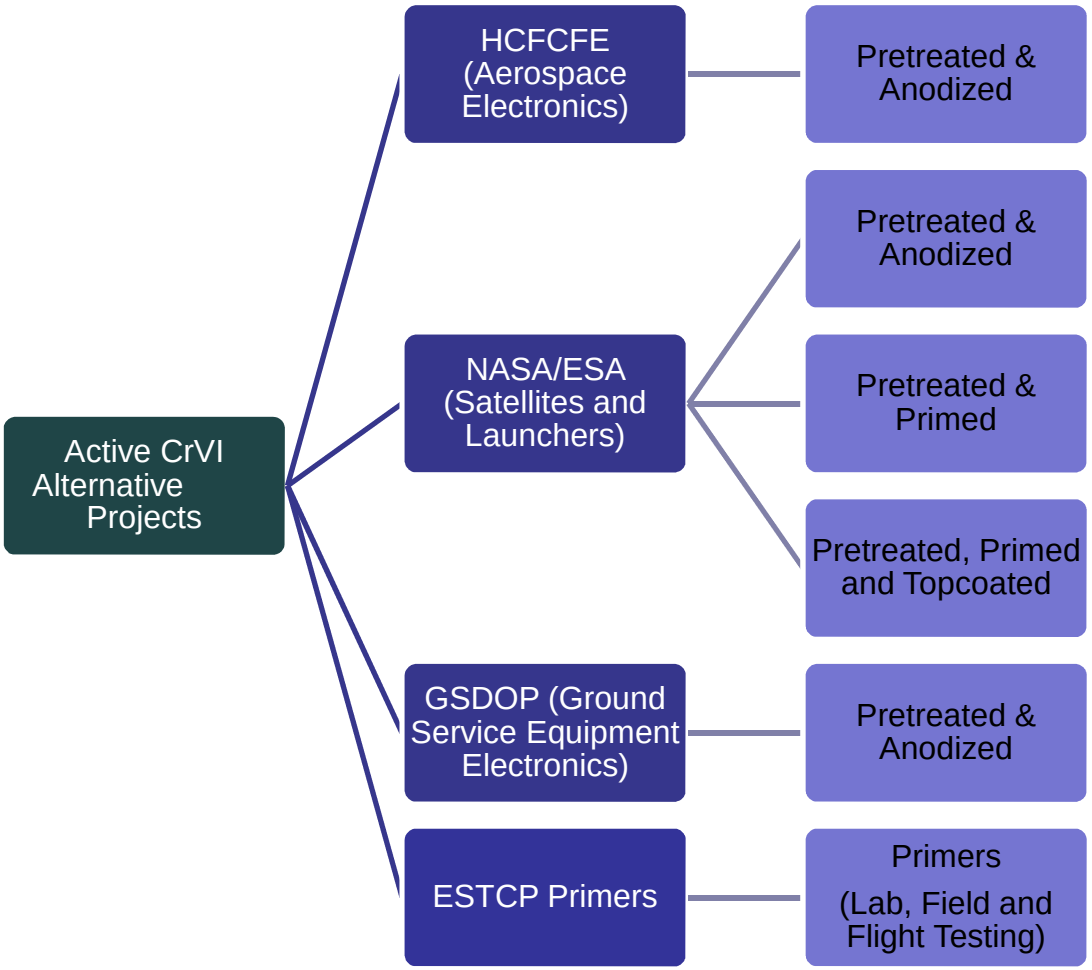
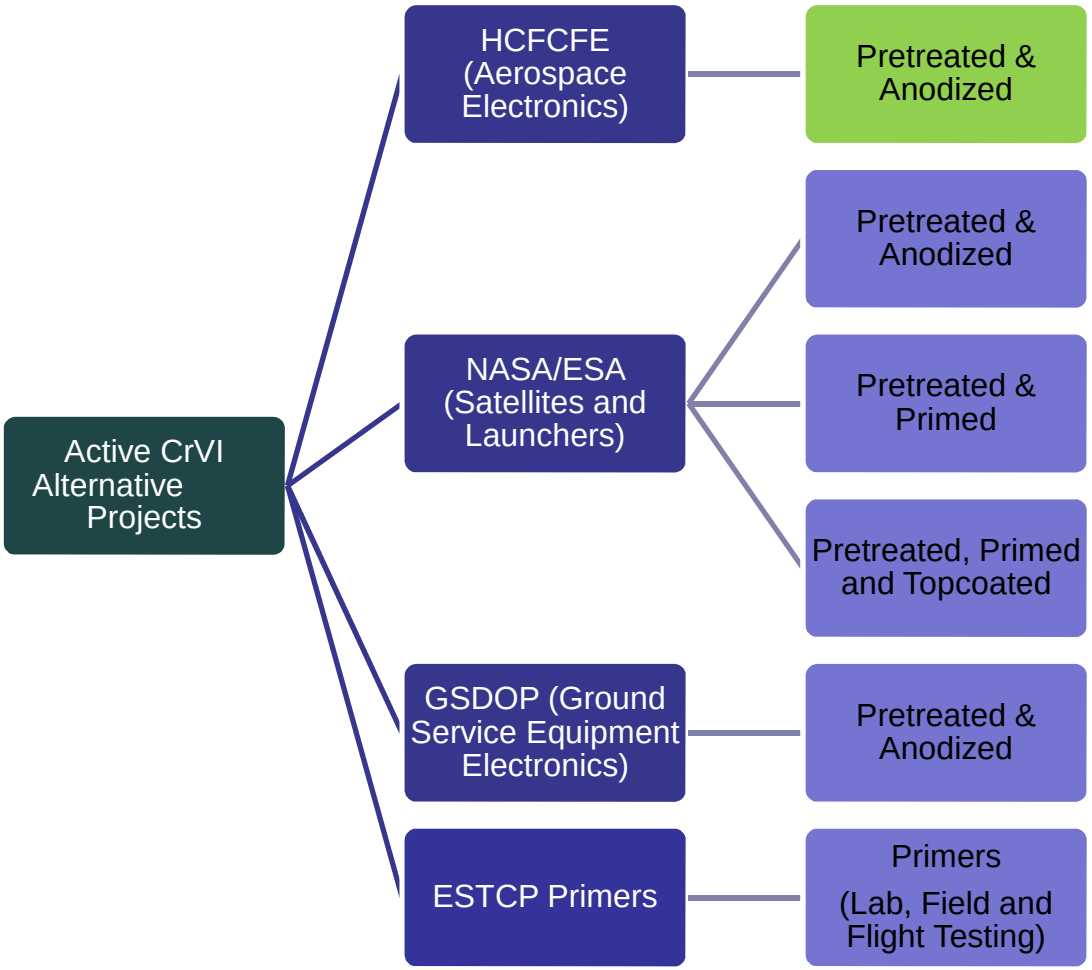
Hex Chrome Free Coatings for Electronics

NASA-DoD-OEM Joint Project

Current NASA TEERM CrVI Projects:



Current NASA TEERM CrVI Projects:



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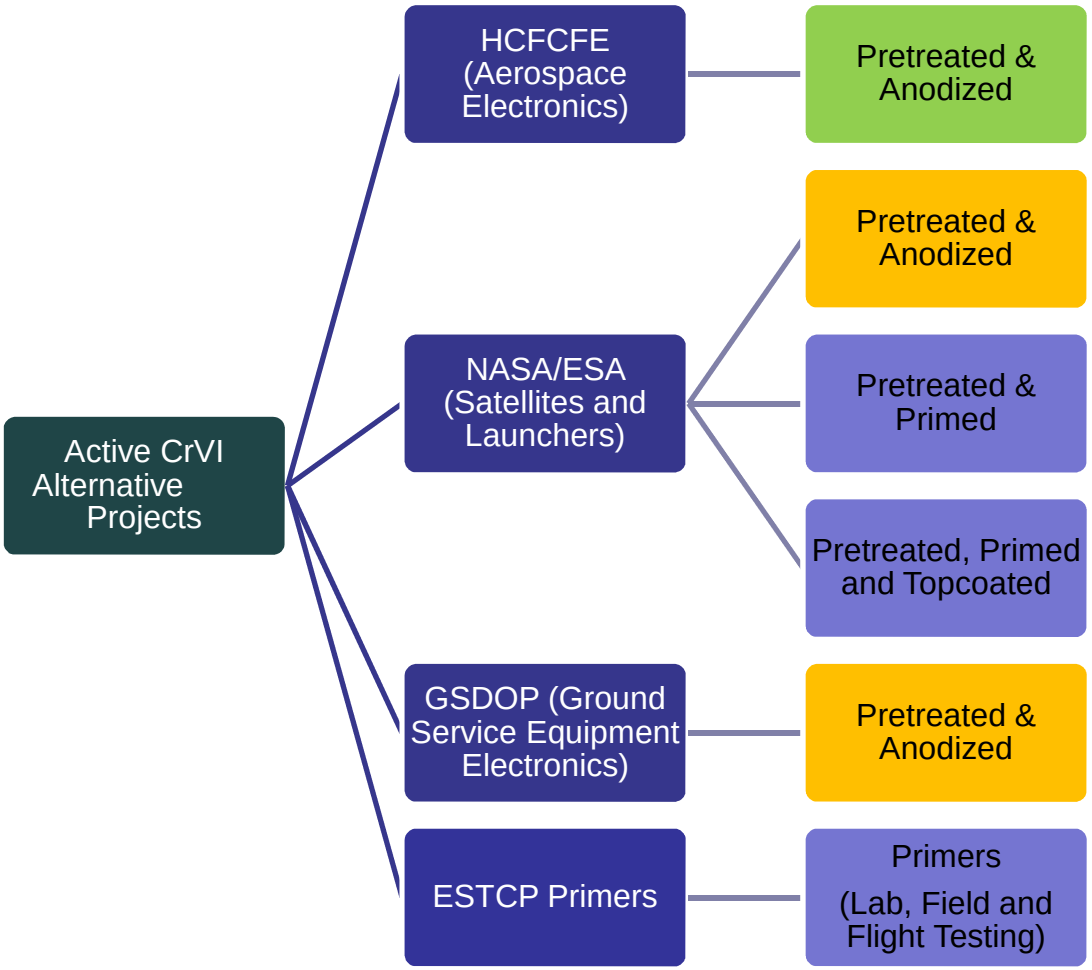

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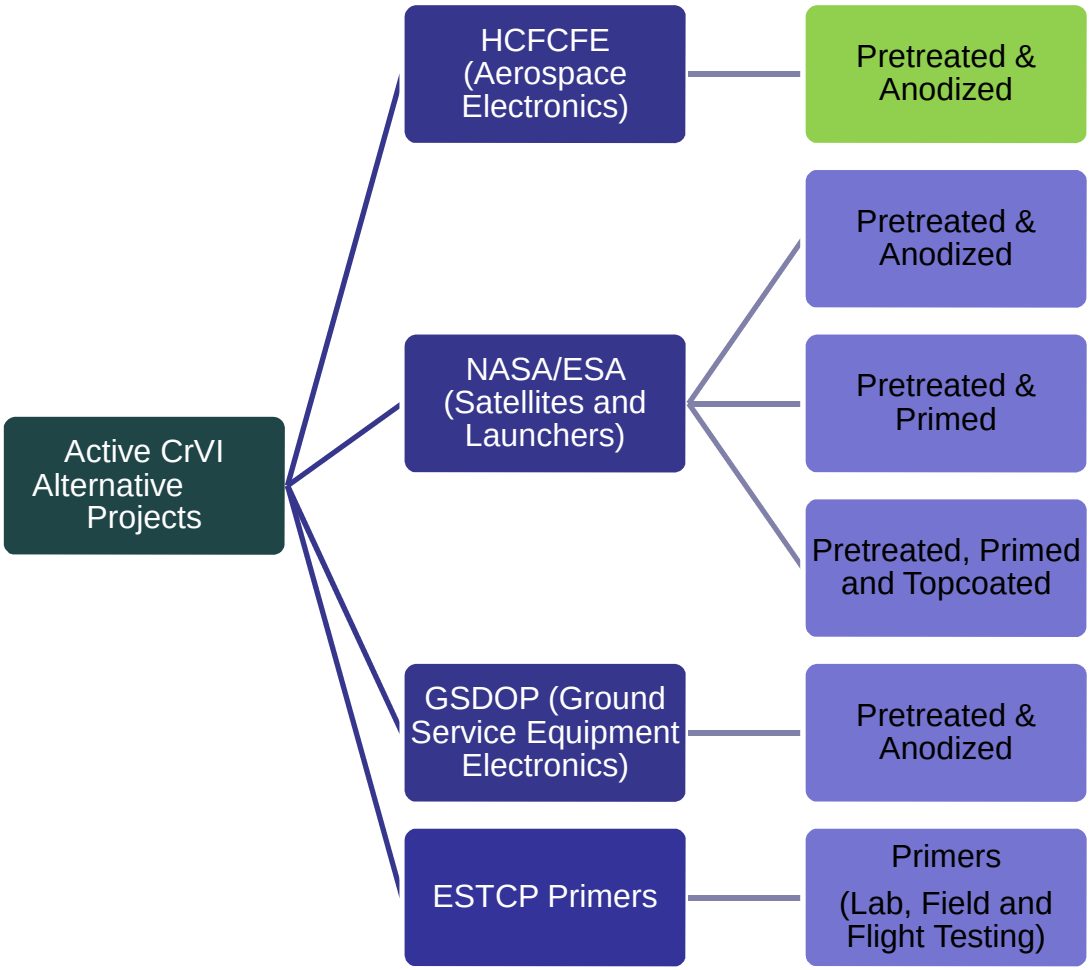

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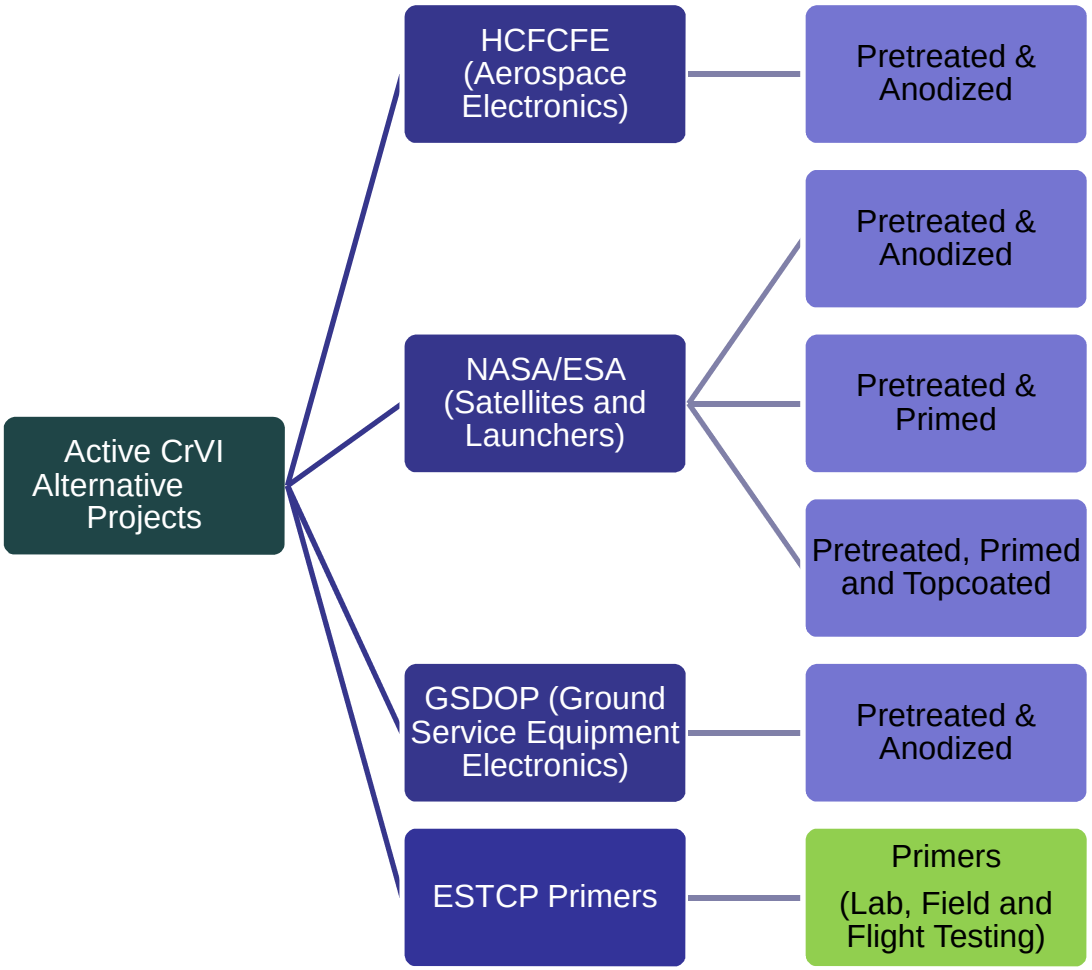


Hex Chrome Free Coatings for Electronics (NASA-DoD)

Objective

- Evaluate and test hexavalent-chrome free pretreatments for avionics and electronics applications

Benefits

- Project builds off of previously successful NASA and DoD testing
- Reduced risk for materials obsolescence of hex-chrome coatings with the discovery of coatings that perform to the requirements for current and future Programs within NASA, the DoD and ESA
- Continue to collaborate with DoD and industry to identify and test alternatives for various applications within the aerospace community

If a qualified technology or product is implemented, it will:

- Meet environmental and safety regulatory requirements
- Reduce need to monitor for chromium exposure due to new regulations
- Decrease risk of environmental, worker and public exposure
- Reduce maintenance cost and government liability

Hex Chrome Free Coatings for Electronics (NASA-DoD)

Pretreatments

- Alodine 1200S (Control)
- Metalast TCP-HF
- SurTec 650 C
- Iridite NCP

Substrates

- 6061-T6
- 7075-T73
- 2024-T3

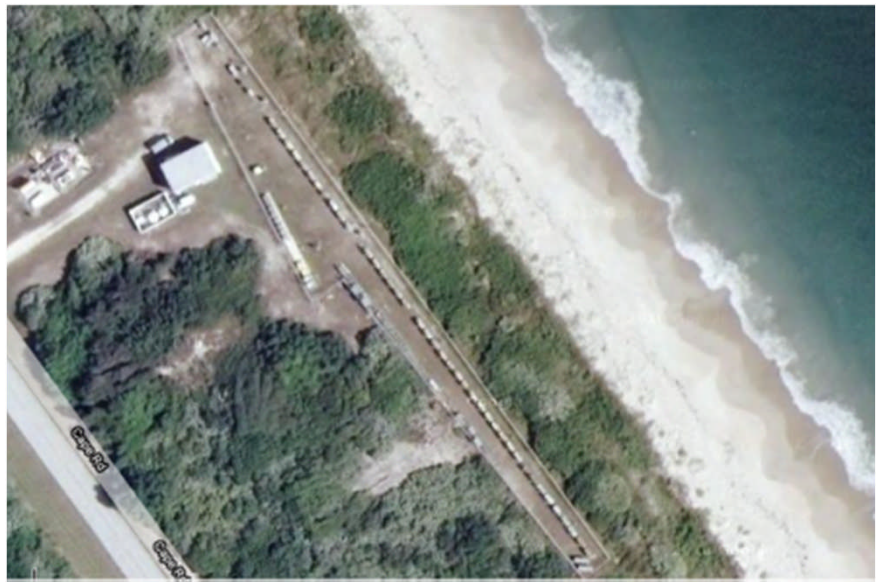
Limited Screening Tests

- Metalast NEW TCP-HF

Hex Chrome Free Coatings for Electronics (NASA-DoD)

Testing {NASA KSC Corrosion Technology Lab and Beachside Corrosion Lab}

- Salt Spray Resistance
  - ASTM B 117
    - To failure
- Cyclic Corrosion
  - ASTM G 85, Annex 5
- 18-Month Marine Environment
  - KSC Beach Corrosion Test
- Wet Tape Paint Adhesion
  - 24 Hour Immersion
  - 96 Hour Immersion at 120^{o}F



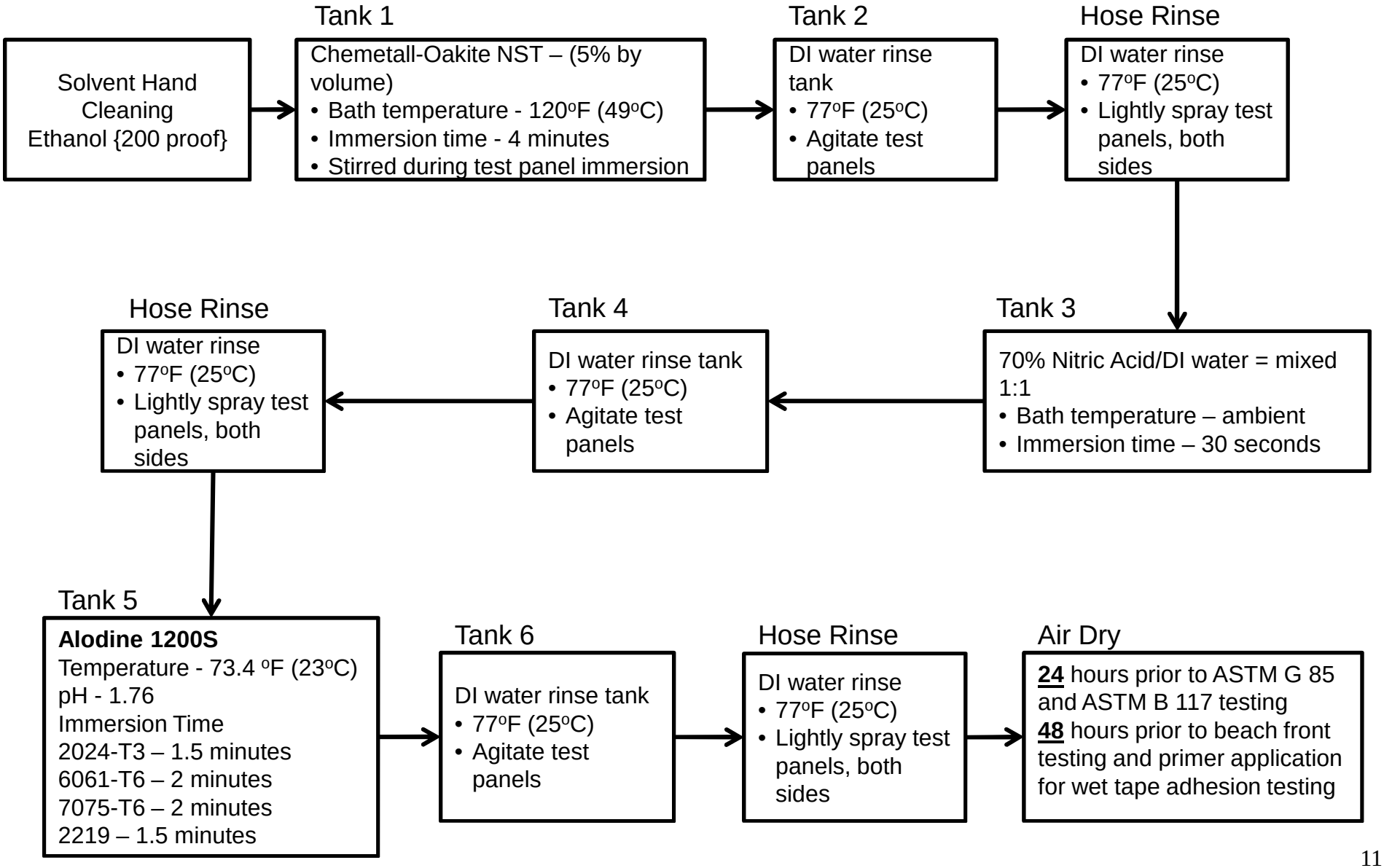
Hex Chrome Free Coatings for Electronics (NASA-DoD)

Panel Preparation {NASA KSC Corrosion Technology Lab}

- The panel preparation procedure was developed as part of the NASA TEERM Hexavalent Chrome Alternatives for Aerospace Project. Stakeholders participating in the Hexavalent Chrome Free Coatings for Electronics Applications Project agreed to the procedure. Two separate processes were used for this project.

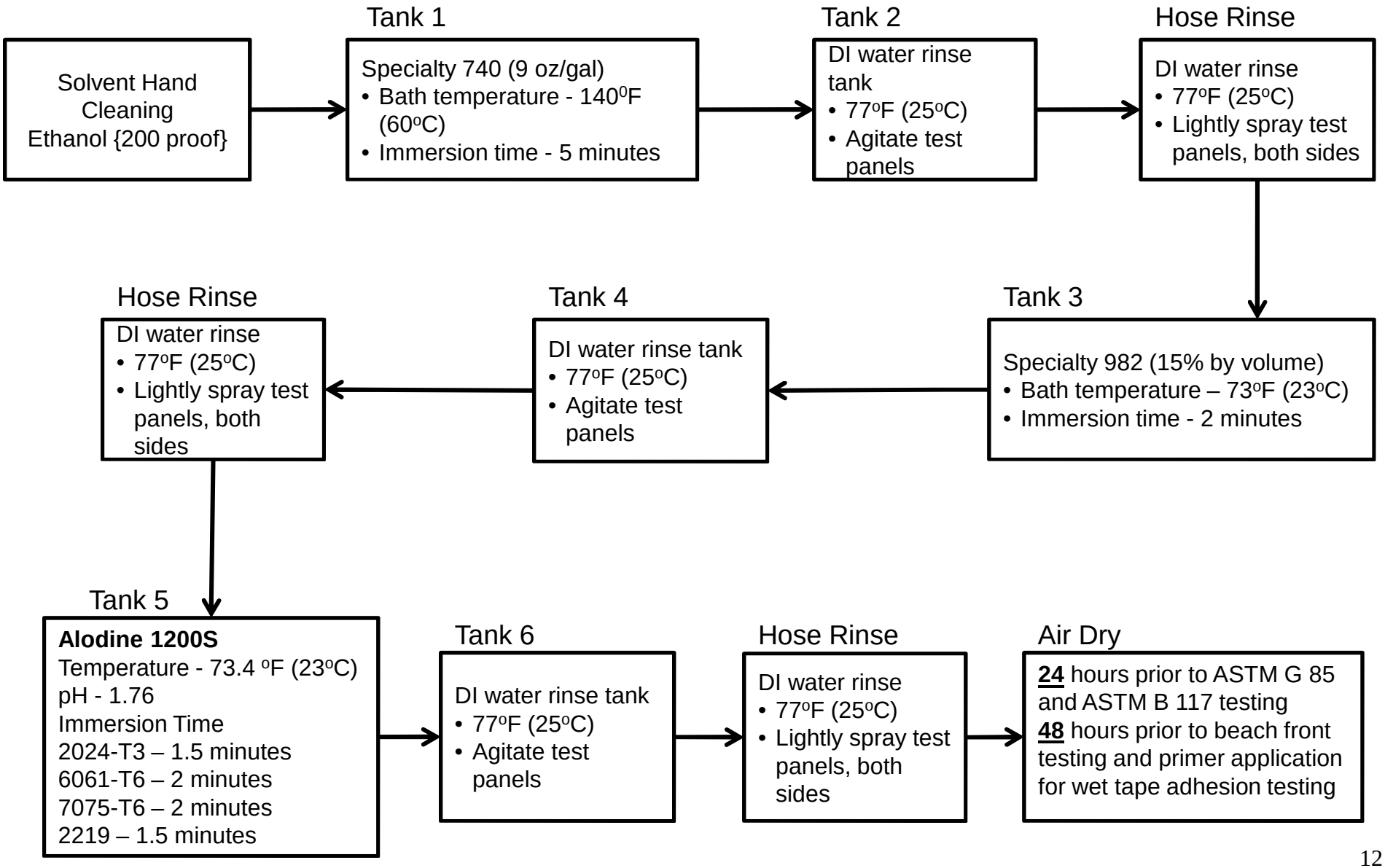
National Aeronautics and Space Administration (NASA)

Process 1



National Aeronautics and Space Administration (NASA)

Process 2



Screening test results

Hex Chrome Free Coatings for Electronics (NASA-DoD)

Salt Spray Resistance (ASTM B 117)

Process 1		
Pretreatment	**Alloy**	**Results**
Hex-Chrome Control	2024-T3	2/6 pass @ 168 hrs : all fail @ 336 hrs
	2219	All fail @ 168 hrs
	6061-T6	6/6 pass @ 672 hrs : 5/6 pass @ 840 hrs
	7075-T6	6/6 pass @ 336 hrs : 1/6 pass @ 840 hrs
Tri-Chrome 1	2024-T3	6/6 pass @ 168 hrs : 1/6 pass @ 336 hrs : all fail @ 504 hrs
	2219	All failed @ 168 hrs
	6061-T6	6/6 pass @ 840 hrs
	7075-T6	6/6 pass @ 672 hrs : 4/6 pass @ 840 hrs
Tri-Chrome 2	2024-T3	1/6 pass @ 168 hrs : all fail @ 336 hrs
	2219	All fail @ 168 hrs
	6061-T6	All pass @ 840 hrs
	7075-T6	All pass @ 840 hrs
Non-Chrome	2024-T3	All fail @ 168 hrs
	2219	All fail @ 168 hrs
	6061-T6	2/6 failed @ 168 hrs : 3/6 pass @ 840 hrs
	7075-T6	6/6 pass @ 168 hrs : 2/6 pass @ 840 hrs
Testing stopped at 840 hours		
Inspected per MIL-DTL-5541		

Hex Chrome Free Coatings for Electronics (NASA-DoD)

Salt Spray Resistance (ASTM B 117)

Process 2		
Pretreatment	**Alloy**	**Results**
Hex-Chrome Control	2024-T3	All fail @ 168 hrs
	2219	All fail @ 168 hrs
	6061-T6	All pass @ 840 hrs
	7075-T6	5/5 pass @ 672 hrs : all fail @ 840 hrs
Tri-Chrome 1	2024-T3	5/5 pass @ 168 hrs : 1/5 pass @ 336 hrs : all fail @ 504 hrs
	2219	All fail @ 168 hrs
	6061-T6	All pass @ 840 hrs
	7075-T6	All pass @ 840 hrs
Tri-Chrome 2	2024-T3	All fail @ 168 hrs
	2219	All fail @ 168 hrs
	6061-T6	All pass @ 840 hrs
	7075-T6	5/5 pass @ 504 hrs : 3/5 pass @ 840 hrs
Non-Chrome	2024-T3	All fail @ 168 hrs
	2219	All fail @ 168 hrs
	6061-T6	5/5 pass @ 168 hrs : 2/5 pass @ 672 hrs : all fail @ 840 hrs
	7075-T6	All fail @ 168 hrs
Testing stopped at 840 hours		
Inspected per MIL-DTL-5541		

Hex Chrome Free Coatings for Electronics (NASA-DoD)

Wet Tape Paint Adhesion (24 hour immersion, ambient temp)

Process 1		
Primer MIL-PRF-85582 : Deft 44-GN-07A		
Pretreatment	**Alloy**	**Results**
Hex-Chrome Control	2024-T3	5A
		5A
	7075-T6	5A
		5A
Tri-Chrome 1	2024-T3	5A
		5A
	7075-T6	5A
		5A
Tri-Chrome 2	2024-T3	5A
		5A
	7075-T6	5A
		5A
Non-Chrome	2024-T3	5A
		5A
	7075-T6	5A
		5A

Process 2		
Primer MIL-PRF-23377 : PPG CA7233		
Pretreatment	**Alloy**	**Results**
Hex-Chrome Control	2024-T3	5A
		5A
	7075-T6	5A
		5A
Tri-Chrome 1	2024-T3	5A
		4A
	7075-T6	4A
		4A
Tri-Chrome 2	2024-T3	5A
		5A
	7075-T6	4A
		4A
Non-Chrome	2024-T3	5A
		5A
	7075-T6	5A
		5A

- 5A = No peeling or removal
- 4A = Trace peeling or removal along incisions or at their intersection
- 3A = Jagged removal along incisions up to 1.6 mm (1⁄16 in.) on either side
- 2A = Jagged removal along most of incisions up to 3.2 mm (1⁄8 in.) on either side
- 1A = Removal from most of the area of the X under the tape
- 0A = Removal beyond the area of the X

Hex Chrome Free Coatings for Electronics (NASA-DoD)

Wet Tape Paint Adhesion (96 Hour Immersion at 120°F)

Process 1		
Primer MIL-PRF-85582 : Deft 44-GN-07A		
Pretreatment	**Alloy**	**Results**
Hex-Chrome Control	2024-T3	5A
		5A
	7075-T6	5A
		5A
Tri-Chrome 1	2024-T3	5A
		5A
	7075-T6	5A
		5A
Tri-Chrome 2	2024-T3	5A
		5A
	7075-T6	5A
		5A
Non-Chrome	2024-T3	5A
		5A
	7075-T6	5A
		5A

Process 2		
Primer MIL-PRF-23377 : PPG CA7233		
Pretreatment	**Alloy**	**Results**
Hex-Chrome Control	2024-T3	5A
		5A
	7075-T6	5A
		4A
Tri-Chrome 1	2024-T3	5A
		4A
	7075-T6	4A
		4A
Tri-Chrome 2	2024-T3	5A
		5A
	7075-T6	4A
		4A
Non-Chrome	2024-T3	5A
		5A
	7075-T6	5A
		5A

- 5A = No peeling or removal
- 4A = Trace peeling or removal along incisions or at their intersection
- 3A = Jagged removal along incisions up to 1.6 mm (1⁄16 in.) on either side
- 2A = Jagged removal along most of incisions up to 3.2 mm (1⁄8 in.) on either side
- 1A = Removal from most of the area of the X under the tape
- 0A = Removal beyond the area of the X

Hex Chrome Free Coatings for Electronics (NASA-DoD)

KSC Beach Front Testing

Hex Chrome Free Coatings for Electronics (NASA-DoD)

KSC Beach Front Testing

Test panels have been on the beach for 36 days as of November 29, 2012.

- Salt residues are starting to accumulate on the test panels.
- The test panels will remain at the beach for a least a total of 90 days

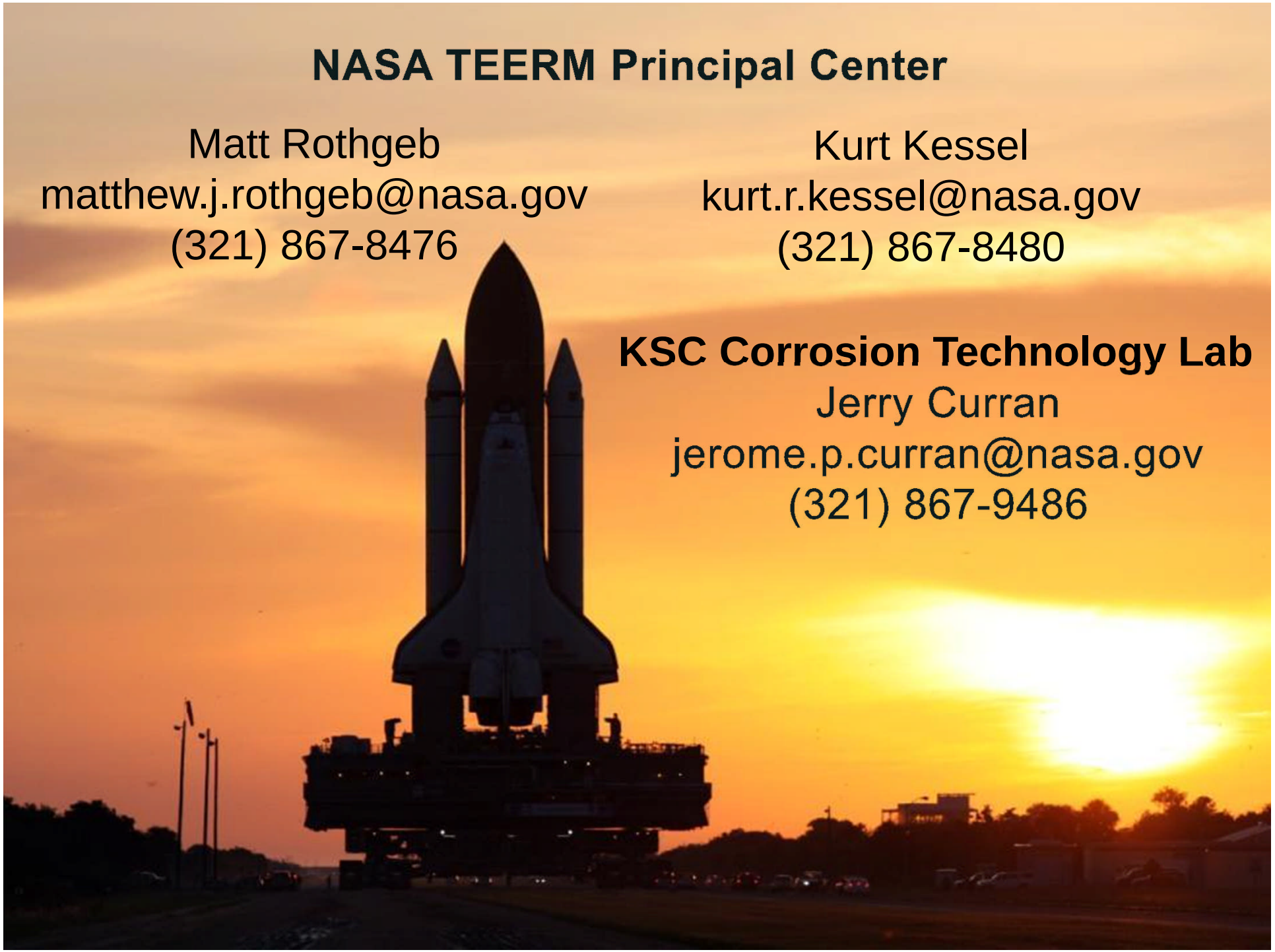
Hex Chrome Free Coatings for Electronics (NASA-DoD)

Next Steps

1. Analysis of panels from corrosion testing
   - Developing ranking criteria now

2. Down select best performers (regardless of pass/fail)
   - Up to 4 pretreatments

3. Continue testing selected pretreatments for:
   - HCFCFE (Avionics / Electronics)
     - Bonding, EMI/RFI
   - GSDOP (Ground Service / Electronics
     - Boding, EMI/RFI
   - NASA/ESA (Spacecraft & Launchers)
     - Continued Pretreatment Testing
     - Pretreatment + Primer (Full matrix) Screening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Questions?

ADDITIONAL SLIDES

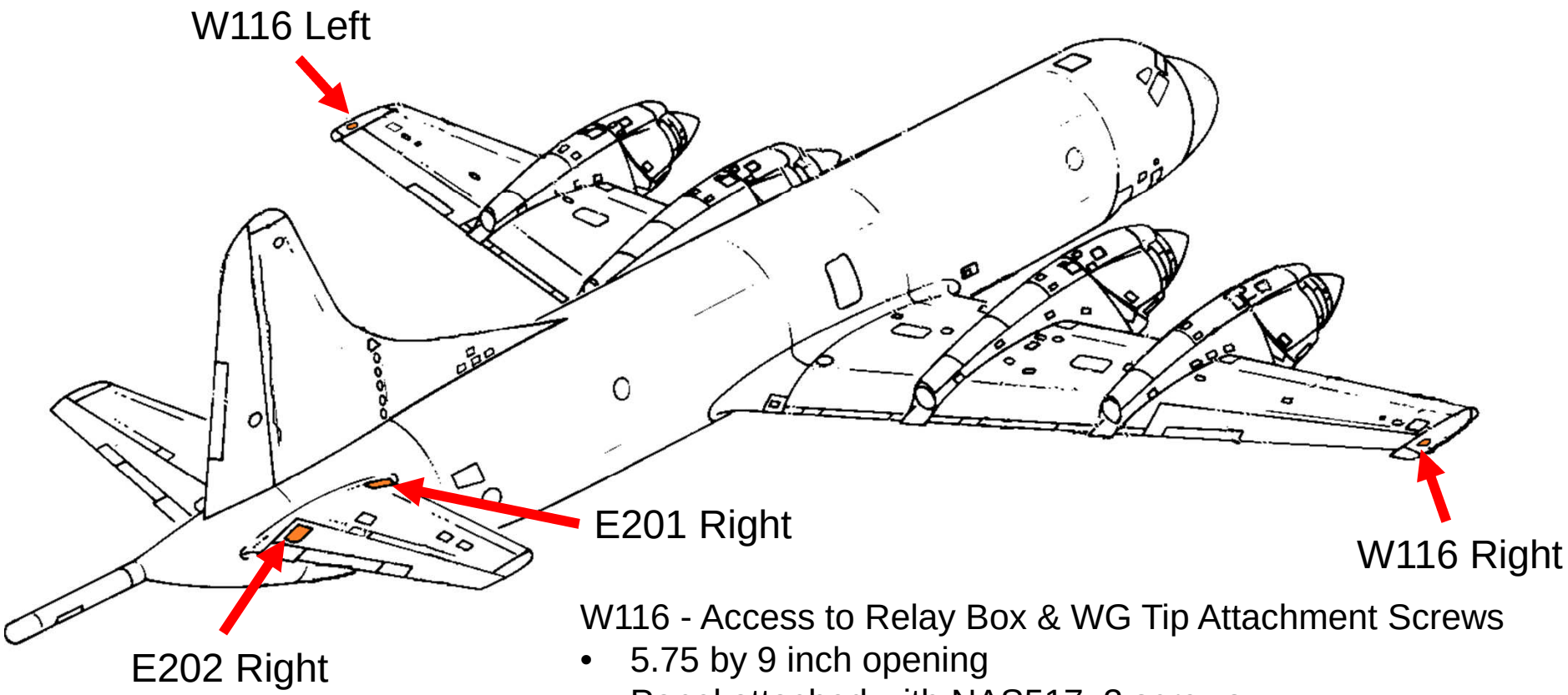
ESTCP PRIMERS PROJECT
P-3 FLIGHT DEMONSTRATION

ESTCP Primer Evaluation

NASA's P-3 Orion Aircraft – Stationed at WFF

Coating Systems to be evaluated:

System 1: TCP + Deft 084 + NASA Topcoat
System 2: TCP + NAVAIR Coating + NASA Topcoat
System 3: TCP + Hentzen16709 + NASA Topcoat



W116 - Access to Relay Box & WG Tip Attachment Screws

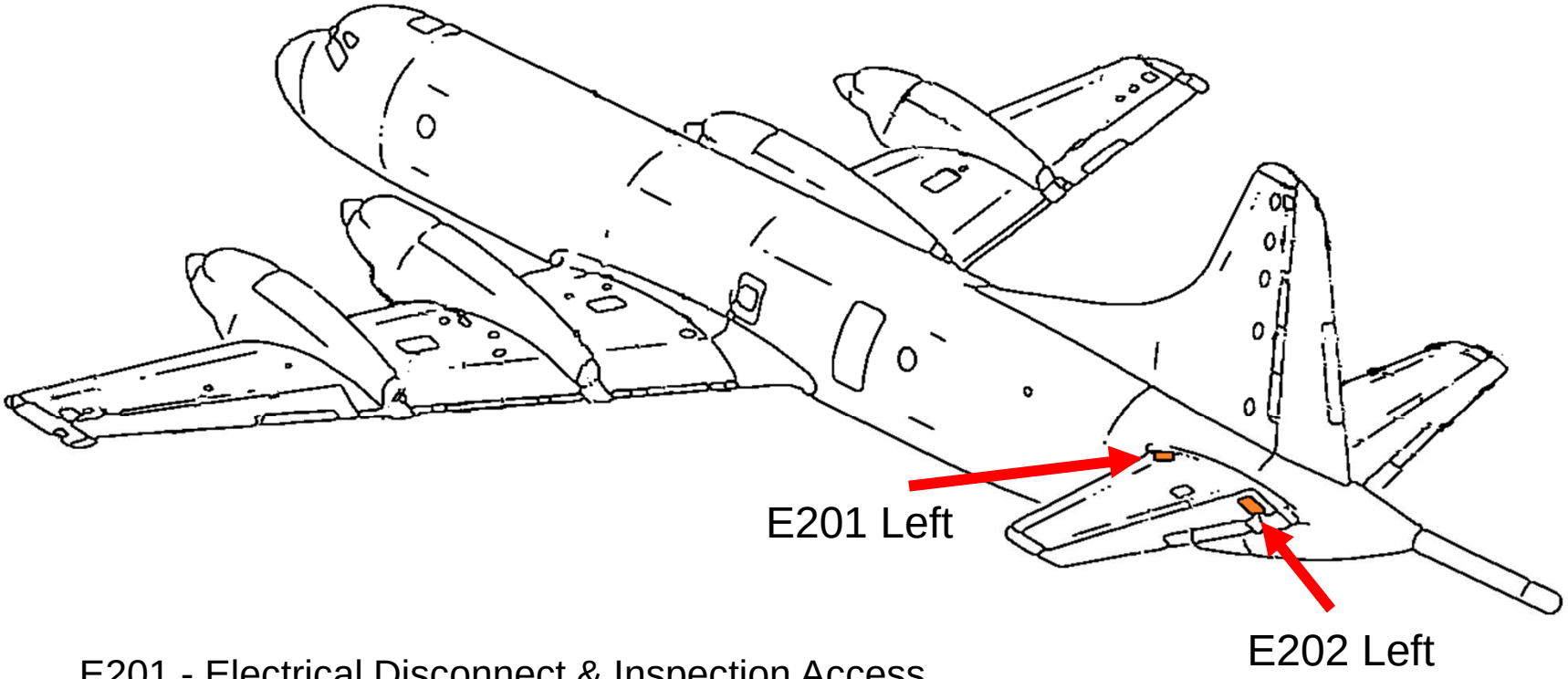
- 5.75 by 9 inch opening
- Panel attached with NAS517–3 screws

E201 - Electrical Disconnect & Inspection Access

- 4.5 by 13.5 inch opening
- Panel attached with NAS517–3 screws

E202 - Force Tab Balance Weight and Linkage Access

- 10.25 by 12 inch opening
- Panel attached with NAS517–3 screws

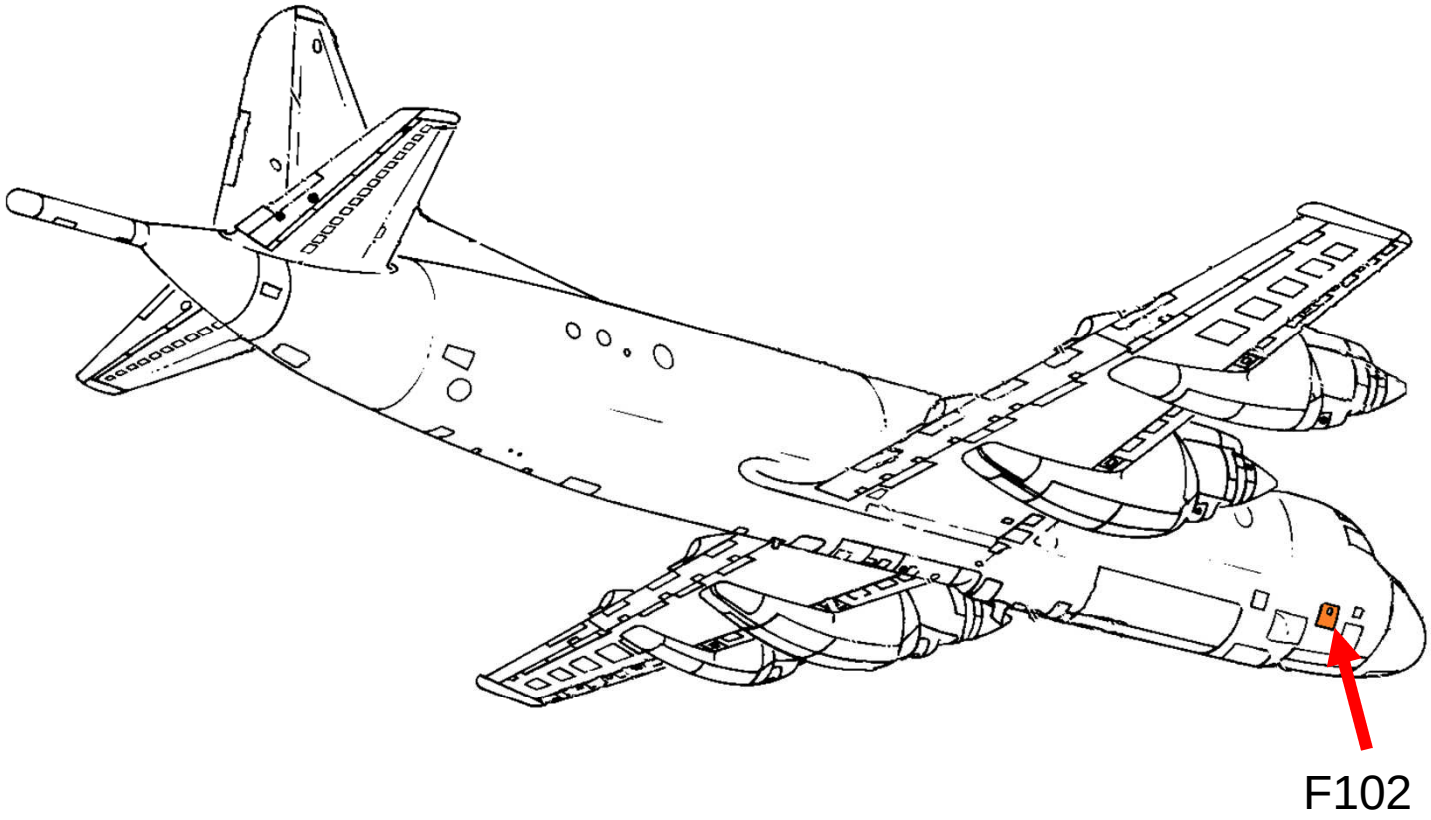


E201 - Electrical Disconnect & Inspection Access

- 4.5 by 13.5 inch opening
- Panel attached with NAS517–3 screws

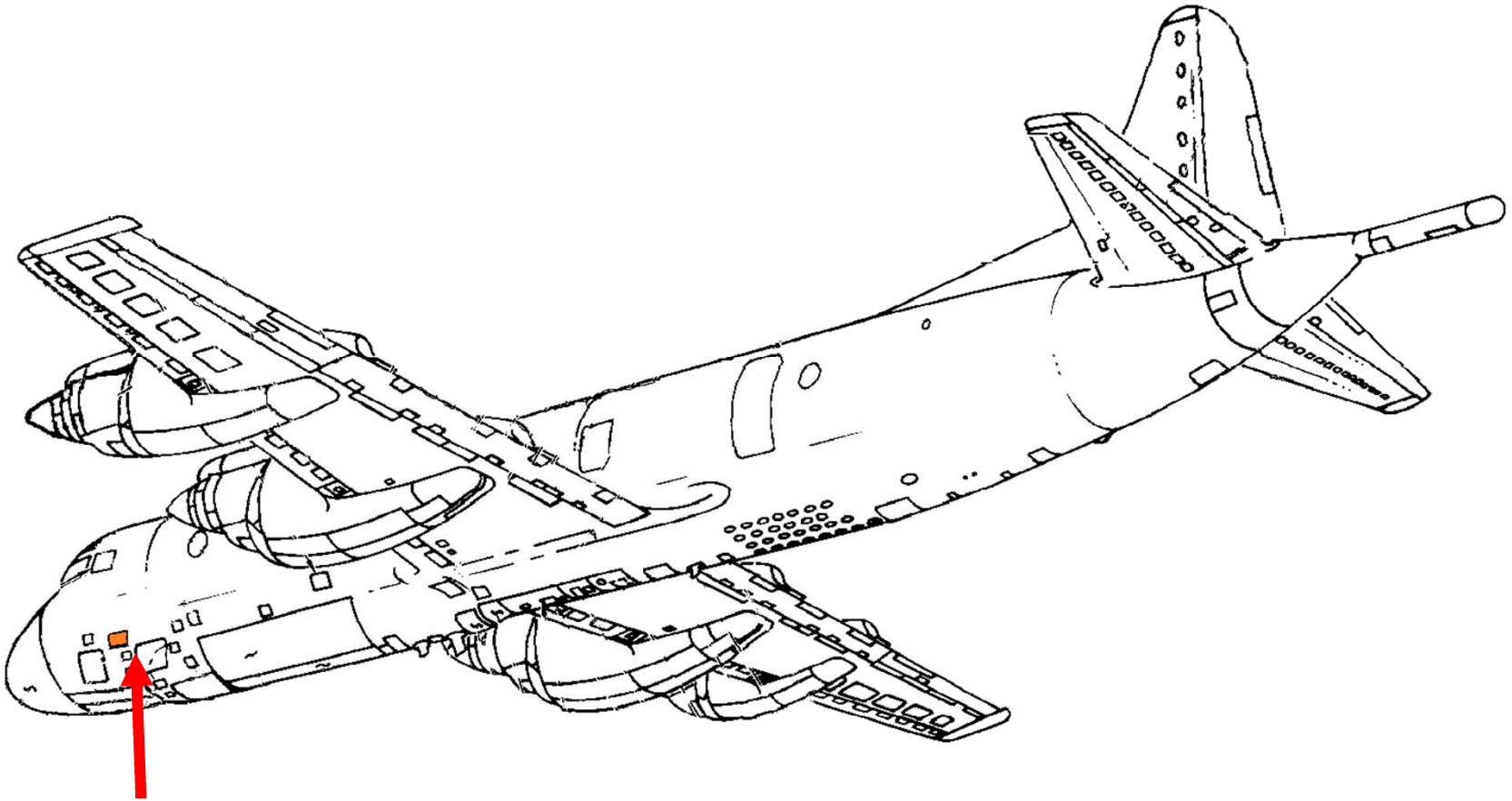
E202 - Force Tab Balance Weight and Linkage Access

- 10.25 by 12 inch opening
- Panel attached with NAS517–3 screws



F 102 - Air Condition Duct Access

- 11.25 by 16.25 inch opening
- Panel attached with NAS517 screws
- Panel contains a 4 by 5 inch opening with hinged door secured with latches



F103 – Air Condition Duct Access

- 11 by 16.25 inch opening
- Panel attached with NAS517 screws
- Panel contains a 4.25 by 5 inch hinged door secured with latches